Exemption No. 6468A

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
RENTON, WASHINGTON 98055-4056

In the matter of the petition of

Learjet Incorporated **Regulatory Docket No. 28544**

for exemption from 14 CFR § 25.783(h)

GRANT OF EXEMPTION

By letter dated April 24, 1997, Mr. William W. Greer, Vice President for Engineering, Learjet Inc., One Learjet Way, Wichita, KS 67209-2942, petitioned for exemption from certain passenger entry door emergency exit requirements of 14 CFR § 25.783(h) for the Learjet Model 45 airplane.

Sections of the FAR affected:

Section 25.783(h) requires that each passenger entry door in the side of the fuselage must qualify as a Type A, Type I, or Type II passenger emergency exit and must meet the requirements of §§ 25.807 through 25.813 that apply to that type of passenger emergency exit.

Related sections of the FAR:

Section 25.807, in pertinent part, defines the minimum sizes and other attributes of the various emergency exit types, prescribes ditching exit requirements, and establishes the minimum acceptable emergency exit configurations for given passenger occupancies.

Section 25.809 prescribes certain general attributes that each type of emergency exit must have, including means of opening and provisions against jamming.

Section 25.811 requires, in pertinent part, emergency exits to be marked, their locations identified, and their means of operation displayed.

Section 25.812 requires an emergency lighting system of certain attributes.

Section 25.813 prescribes the access that is required to types of emergency exits.

The petitioner's supportive information is as follows:

"We request exemption from a portion of § 25.783(h) for our Model 45 airplane; specifically the requirement that the cabin entry door qualify as a Type A, Type I, or Type II emergency exit. The relief would allow part of the cabin entry door to be used as a qualified emergency exit. The exit would be the upper portion of the two-piece clamshell cabin entry door. The exit exceeds the requirements to qualify as a Type III exit, exceeds the width requirement of a Type II exit and, in fact, the area provided is 50% greater than the Type II exit area. The exit will comply with § 25.807(a)(3) and the applicable sections of §§ 25.807(b) through 25.813 as required by the remainder of § 25.783(h)."

"We believe that the proposed design provides a qualified emergency exit at the cabin entry door location which meets the intent of the rule and which provides a level of safety equal to that provided by the rule. We are convinced that the Model 45 door configuration, for an airplane of its size and passenger capacity, is a safer configuration than the floor-level exit dictated by the letter of the rule."

"Description of proposed Model 45 emergency evacuation system

[Pictorial diagrams, photographs, and bullet charts on pp 3-15 of the petition, which is available in the Docket]

"Passenger emergency exit use briefing

"In order to emphasize the procedure meant to be used for emergency evacuation, the following is proposed:

"1. Airplane Flight Manual.
Page 2-13 of the FAA-Approved Airplane Flight Manual (AFM), in the Normal Procedures Section, item 11, of the BEFORE TAXI Procedures, will include a specific instruction to inform the passengers that the forward emergency exit is the upper cabin door and instruct them as to its use. [Figure II-D-1, of the petition, available in the Docket]

"2. Passenger Information Cards.
Available in each pocket will be a card with pictorial illustrations as well as words to

inform the passengers on the location and use of the emergency exits. [Figure II-D-2, of the petition, available in the Docket]

"3. Crew Checklist.

The unapproved checklist published by Learjet and Flight Safety will include a statement similar to that in the AFM, instructing the crew to brief the passengers on location and use of the emergency exits. This checklist is not available yet for the Model 45, but will be when it gets into service.

"In addition, the operational rules of §§ 91.519 and 135.117 require that the pilot in command (PIC), before each takeoff, ensure that the passengers have been briefed, and that the briefing is to include the location and means of opening the passenger entry door and emergency exits. These briefings may be (in the case of Part 91) and shall be (in the Part 135 case) supplemented by the passenger information cards carried on the airplanes.

"External Door Operating Instructions for Rescue

"The lower portion of the cabin entry door will contain operating instructions for use by rescue personnel from outside the aircraft when they want to open both the upper (emergency exit) and lower portions of the door. To facilitate this rescue scenario, the following placard installations are proposed:

"Placard #1: (Figure E2) [of the petition, available in the Docket]

"EMERGENCY EXIT - UPPER DOOR ONLY

"Placard #2: (Figure E3) [of the petition, available in the Docket]

"TO OPEN LOWER DOOR:
1. ROTATE HANDLE ON STEP → (ARROW POINTS TO HANDLE)
2. DISENGAGE SECONDARY LATCH (ARROW POINTS TO LATCH) ←
3. LET DOOR DEPLOY DOWN

"COMMENTS IN SUPPORT OF PETITION

"Safety Record

"The information and data presented in this paragraph are intended to show that a door design similar to that proposed for the Model 45 has been in service for over 30 years on the Learjet family of aircraft. This design provides a proven means to safely and efficiently evacuate the airplane in typical accident scenarios encountered by this class of aircraft, meaning small to medium business jet aircraft where the bottom of the emergency exit opening is less than 6 ft. above the ground when the aircraft is on its landing gear. The maximum number of occupants certificated in the Learjet family is 13, and specifically for the Model 45, we wish to address 12 maximum in this petition.

- Approximately 1,900 aircraft built.

- Over 30 years of production.
- 11 million flight hours.
- At least 96 evacuations.
- No [Airworthiness Directives] ADs related to egress configuration.
    - 80-07-09, Safety-wire upper-door pivot bolts.
    - 78-25-02, 36-inch cabin door bolt inspection (35/36).
    - 77-19-02, 36-inch cabin door bolt inspection (20 series).
- No [National Transportation Safety Board] NTSB recommendations for improvement.
- Numerous certification evacuation tests. All successful.
- FAA comment, 'The FAA is not aware of any service history indicating that these small exits are not satisfactory for the smaller transport category aircraft.' (Source: Federal Register comment regarding Part 25, Amdt. 25-88.)

"Accident Evacuation Data

"A detailed search of all the accident records in Learjet's possession was made, the results of which are summarized below. Appendix 1 [of the petition, available in the Docket] is a tabular print-out of the accident data base for each of the 96 accidents studied.

"Out of the 96 cases involving evacuations following accidents, gear position is unknown or irrelevant in 20 cases. So we have reliable gear information in 76 cases. Landing gear position is a key factor in the discussion of our petition, as will become evident in later paragraphs.

"GEAR POSITION	OCCURRENCES	% OF 76
All Down	10	13%
All Up (Belly)	48	63%
Main Fail, Nose OK	5	6.6%
Nose & Left Main Fail	4	5.3%
Nose Fail, Mains OK	8	10.5%
Right Main Fail	1	1.3%
	76	

"This data indicates that of the cases where gear position was known, the majority of the evacuations take place with the airplane on its belly, which is precisely the scenario most likely to result in floor, fuselage bottom, and lower-door damage. In 63 percent of the total occurrences where gear position was known, the airplane was on its belly, and 87 percent of the total was with one or more gear collapsed.

"Data on which exit was used and how effective the exits were is not recorded in many of the accident files at Learjet, nor is it in the NTSB's Briefs of Accidents. General aviation accidents do not receive the same level of investigative resources or interest from governmental authorities as do air carrier accidents, hence there is much less information available. However, of the 96

cases studied, there was indication in 44 cases of the exit used. That information is presented in the following summary:

"EXIT USED	OCCURRENCES
Unknown	52
Hole in Fuselage	1
Main Cabin Doors	9
Overwing, Aft Exit	6
Upper Cabin Door	24
Upper Cabin Door and Hole in Fuselage	1
Upper Cabin Door and Aft Exit	3

"This data shows that in the 44 recorded 'known' cases, the upper cabin door was used by itself 55 percent of the time and with other exits another 9 percent of the time.

"Comments recorded in the files concerning the evacuations are as follows:

"23-028A Passenger stated he was impressed with the extremely easy operation of the upper cabin door.

24-103 Passenger wrote letter about how well the escape system worked. (Aft, overwing exit was used.)

25-021 Several passengers stated they did not know where the emergency exit was. (All ambulatory passengers, however, did exit through the upper cabin door.)

55-103 Crew stated door opened easily.

"There are a few specifically noted cases which indicate that the two-piece door design provides an advantage.

24-169 Fuselage was resting on lower cabin door. (Exited upper cabin door.)

35-013 Aircraft buried in snow bank up to main cabin door. (Exited upper cabin door.)

35A-184 Steel channel rammed through the cockpit and lower cabin door, making the lower door inoperable. (Exited upper cabin door.)

"Had the door configuration not been the two-piece clamshell type door in these cases, the forward exit would have been unusable. That feature definitely enhanced the evacuation possibilities in those cases.

"Post-crash fires were present in 15 cases of the 96, and of those 15, the landing gear position was ascertained for 12 cases - all 12 gear-up or collapsed. In all 12 cases, an emergency evacuation was made, and in 9 of the 12 cases, only the forward upper cabin door was used to exit the airplane. In two cases, the aft hatch alone was used, and in one case, both exits were used. The following table lists the accidents wherein post-crash fire was involved.

"AIRCRAFT	GEAR POS'N	EXIT USED
55-107	belly	upper cabin door
23-001	belly	upper cabin door
23-008	?	?
23-021	belly	upper cabin door
23-028A	belly	upper cabin door
24-103	belly	aft hatch
24-110	belly	upper cabin door
24-231	?	?
24-282	belly	forward and aft
24-302	belly	upper cabin door
25-103	belly	aft hatch
25-138	belly	upper cabin door
25-153	?	aft
31-001	belly	upper cabin door
55-007	belly	upper cabin door

"Accident Photographs

"The photographs shown on the following pages [pp 25-43 of the petition, available in the Docket] depict the range of damage a small-fuselage airplane like a Learjet can sustain in various accident scenarios. The damage ranges from relatively minor to very severe. Most of the survivable accident photographs show the airplane on its belly. Not all were survivable accidents, but are included to show that the emergency exit was still able to be opened even after some very severe crash damage.

"Alternative Door Design Concepts

"A condition of the FAA's partial grant of exemption (Exemption No. 6468, dated June 26, 1996) directed Learjet to immediately begin the developments necessary to provide an entry door that fully complies with the letter and intent of the certification requirements. In accordance with that condition, we conducted a study of several alternative door design concepts. Listed below are the requirements on which Learjet based the concepts, plus a listing and discussion of each concept.

"Requirements

"The first requirement is that the door meet the requirements of § 25.783.

"FAA [Advisory Circular] AC 25.783-1 presents an acceptable means of demonstrating compliance with § 25.783. For the existing door design, AC 25.783-1 was followed extensively, such that the door latches are locked, the locks do not engage until the latches are fully engaged, and airplane pressurization is prohibited until the locks are properly engaged. The present Model 45 door mechanism has been accepted by both the FAA and [Joint Airworthiness Authority] JAA. Any design changes would need to maintain current mechanism integrity. Furthermore, Learjet is following a joint FAA/JAA certification process, and for fuselage doors, the JAA team has levied [Notice of Proposed Amendment] NPA 25D-218 as the requirement for showing compliance with [Joint Airworthiness Requirement] JAR 25.783.

Issue Paper AG-3 for the Model 45 defines how Learjet will substantiate structural integrity of the door relative to the locking mechanism. "By meeting the requirements of the Issue Paper, Learjet has been allowed to lock latch pin sets instead of each latch pin directly. This was necessary so that the latching/locking mechanism would be as simple as possible, and also so that both mechanisms could fit within the door envelope. Any changes to the door to meet the exemption condition will need to be consistent with the requirements of this issue paper.

"Next, Learjet has set an internal requirement that the upper door should be allowed to open independently of any failures in the lower door, which are primarily lower door mechanism jams. This requirement is based upon Learjet's excellent service history with the upper door, and also upon the fact that the lower door is more susceptible to jamming because the cabin floor/lower door hinge are near the bottom of the fuselage (true for all Learjet-sized airplanes). Another reason for this requirement is that interconnecting the upper door and lower door mechanisms would result in a larger, more complex latching/locking mechanism which, due to the increased number of components, would also make the mechanism more susceptible to jamming.

"The remaining requirements are: minimize design impact to upper and lower doors for economic reasons; keep operation simple and obvious; the doors must be easily openable or closable by one person from either the inside or outside of the airplane; and the lower door lock concept, which is a baulk pin stop between the upper and lower halves, must be maintained.

"Concepts

"Four interconnect concepts were identified. Each of these concepts attempted to minimize the design impact by keeping the upper and lower doors the same, while providing some interconnect device to activate the lower door via upper door handle rotation.

"Direct Mechanical Interconnect

"A direct mechanical interconnect is envisioned as the meshing of two gearing devices as the doors are pulled shut; one device would be in the upper door and one in the lower door. This concept was rejected because a direct interconnect would violate the requirement that a jam in the lower door should not prevent the upper door from opening. This would be true for any direct mechanical interconnect concept between the upper and lower door.

"Direct/Indirect Mechanical Interconnect

"The second concept was a direct/indirect mechanical interconnect. The basis of this concept is that the upper door handle would directly, via a mechanical interconnect, drive the lower door latch pins into place while compressing a spring in the lower door at the same time. On door opening, the upper handle would disengage the upper door mechanism while the compressed spring would unlatch the lower door latch pins. This concept would still allow the upper door to open should the lower mechanism jam.

"From an operational standpoint, the spring would need to store enough energy to open the latch pins under reasonable loading on the lower door. The spring compression required for this energy would increase handle forces on closing, and would also tend to backdrive the upper door mechanism (unacceptable per NPA 25D-218). To eliminate the backdrive forces, the spring would require some form of lock (a failure of this lock would need to be evaluated). Furthermore, an uplock device would be required to hold the lower door in place while its latch pins were being engaged. The latch/lock mechanism would need to disengage the uplock once the door was fully latched and locked. In consideration of ditching, it would be desirable to allow in-flight engagement of the uplock, which further complicates both the uplock design and operational procedures.

"From a design standpoint, significant redesign of both the upper and lower doors would be required to accommodate the spring cartridge and the mechanism in the upper door to drive the lower door mechanism and spring. Currently, volume in the lower portion of the upper door is completely filled with interconnect latch pin drives and the lower lock. There is no space for additional mechanism in this area. Additionally, if upper door handle forces exceeded 50 lb. (which Learjet believes likely), then the handle gearing would require changes. This would cascade into an impact on the upper latch/lock/vent door timing which would cascade into a complete upper door mechanism/structure redesign. Any significant structural changes to either the lower door or upper door would require redoing portions of fuselage static and fatigue testing.

"Primarily in consideration of the operational characteristics of the spring, but also the design impact, this concept was rejected.

"Electrically Operated Lower Door

"This concept was to install an electric motor in the lower door which would engage/disengage the lower door latch pins. Actuation of the actuator would be via (i) switches on the upper door handle for opening and (ii) switches between the lower door and door frame for closing. This concept would not impact upper handle forces, and therefore there would be no impact to the upper door. Provisions for the door closing switches would require door frame modifications.

"Operationally, there are two major issues with using an electric motor. First, is the time required for the motor to run stop to stop. Typical actuation times for this size motor are 7 to 10 seconds. Based on AC 25.783, the door - upper and lower portions - must be fully opened in 10 seconds. Given that it will take 3 - 4 seconds to open the upper door, actuation times may not be certifiable. Furthermore, the delay due to the motor would create an opening discontinuity between the upper and lower portions. This would likely lead to a scenario where, in a haste to exit, someone will use the lower door to assist in exiting at the same time the latch pins clear the door frame, resulting in possible injury and confusion. The second issue would be a runaway failure mode in the actuator. The existing door design has a baulk pin stop between the upper and lower door. This stop serves three purposes: (i) to prevent the upper door from being latched until the lower door is latched; (ii) to prevent the lower door from being unlatched until the upper door is open; and (iii) to serve as the lock for the lower door pins. Consequently, should the actuator drive the baulk pin against the upper door, then the increased friction of the upper door latch pins may be high enough to prohibit opening of the upper door. This issue is further complicated because as actuator speeds are increased to meet the door opening time requirement, the stall torque of the motor will increase as well. Because Learjet believes these two issues would reduce safety to a level below that of using only the upper door for an emergency exit, this concept was also considered not viable.

"Mechanism Relocation to Fuselage Frames

"The last interconnect concept would be to install the latching and locking mechanism for both upper and lower doors in the surrounding frame structure. This concept would clearly require significant fuselage modifications, which would require redoing static and fatigue testing of the fuselage." Furthermore, a completely new latching, locking, and vent door mechanism would need to be designed. "It would be impossible to drive the two upper/lower interlocking pins with this concept, and to latch them properly. Therefore, this concept was considered not feasible."

"Other Concepts

"Two redesigned door concepts were also evaluated. The first was a single door with an upper hinge, so that the door would swing up. The second concept was to lower the split line between the lower and upper door (so that the upper door would meet Type II exit size requirements, albeit not floor level).

"A single door with an upper hinge would be a large, heavy door which could be difficult to open, and it also would need to rotate up high enough to provide adequate clearance for ingress/egress. A separate stairs would be required plus a water dam for ditching. This would add weight to the aircraft, estimated at 30 - 40 lb. A forward-hinged door would also require a separate stairs and water dam. The aircraft weight increase for a forward-hinged door is estimated at 20 - 30 lb. Either of these would be susceptible to damage in belly landings, and in some cases would likely not open at all.

"Lowering the split line of the clamshell would not yield a floor level exit, thus not being in total compliance with § 25.783(h). The main benefit of this design is that the lower door could still serve as a dam for ditching. However, it would still be a complete upper/lower door structure and latching/locking mechanism redesign. A set of internal steps would also be required since now the lower door would not be large enough to support three steps.

"Each of these concepts would require a complete door redesign and would be a major impact to the Model 45 program. Furthermore, surrounding frame structure would require modifications which would be expensive and time-consuming design changes. Major frame structure and/or door changes would require fuselage static and fatigue re-testing.

<u>"Regarding Amendment 25-15 to Part 25</u>

"The certification basis of the Learjet 45 is Part 25 as amended by Amendments 25-1 through 25-75. Inclusive in this is the requirement in § 25.783(h) that each passenger entry door in the side of the fuselage must qualify as a Type A, Type I, or Type II passenger emergency exit, and must meet the requirements of §§ 25.807 through 25.813 that apply to that type of passenger emergency exit. The proposal for this requirement was published in Notice 66-26, in 1966, in response to studies which showed that during emergency evacuation demonstrations or during actual emergency evacuations, there was a natural tendency for passengers to try to leave by the same route they entered the airplane. The stated intent of the proposal was to require that each passenger door qualify as an emergency exit whether or not it is a required emergency exit. This requirement was adopted by Amendment 25-15, effective October 24, 1967. The original Learjet Model 24 type certification basis did not include Amendment 25-15, so the split, clamshell type entry door was allowed, and the upper half [portion] of that door was certificated as a qualified Type IV emergency exit. Type Certificate Data Sheet (TCDS) AlOCE has been amended numerous times over the years to add derivative Learjet models, but Amendment 25-15 was never incorporated into the T. C. [type certification] basis of any derivatives. That door design, which had been proven successful for the past 30 years, was adopted for the Model 45, and that action necessitated this petition. Note that the petition does not request exemption from the total rule - only the specific requirement that the entry door qualify as a Type A, Type I, or Type II emergency exit. A portion of the Model 45 entry door (its top clamshell half) will fully qualify as a Type III emergency exit, and in fact surpasses the size requirement of a Type III exit by 150%. The stated intent of the proposal in Notice 66-26 (in the FAA's own

words) was to, 'Require that each passenger door qualify as an emergency exit.. . .' The Model 45 door does qualify as an emergency exit; the relief requested pertains only to the type of exit required. Since transport category airplanes had not been required to provide entry door emergency exits prior to Amendment 25-15, it is understandable that those passengers who tended to leave the airplane in an emergency by the same route they entered the airplane, and were not able to do so, had to find other means of exiting. There may have been delays as they attempted to open an un-marked door, or as they went to other exits. That was never the case on Learjets. From the beginning, in 1964, passengers could evacuate the aircraft via the same route they entered, and could do so using a qualified emergency exit. This has been proven in 30 years of operation. The proposed exit configuration clearly meets the intent of Amendment 25-15.

"Suitability of Proposed Exit

"The perceptual and physical abilities of passengers have been considered in discussions regarding the suitability of the Model 45 upper half [portion] of the entry door in its role as a qualified emergency exit. The idea that passengers leaving an airplane in an emergency expect to leave by the same type of door through which they entered the airplane has apparently never been studied, so it cannot be said that they would or would not be unnecessarily challenged by such a confrontation. However, if that were the case, it would seem that all emergency exits would be required to closely resemble the door through which passengers entered the airplane. Certain criteria have been established for the design of emergency exits, such as height, width, step-up and step-down distances, operating means, marking, etc., and these criteria vary, generally, according to the number of people expected to use the exits. Apparently, people have been found to be able to adapt to the configuration they confront, which is dependent upon where they are seated on the airplane. Even leaving by way of the cabin entry door on a 747 by leaping out the door onto a slide 20 or more feet off the ground may challenge the perception and ability of some passengers, but it is a proven, acceptable means of evacuating a 747. Stepping out of an over-wing exit on any commercial air transport, then walking on the wing and having to slide down an extended flap would also challenge the perceptual and physical ability of some people, but it, too, has proven effective. Likewise, in the case of Learjet's forward emergency exit, which for 30 years has been the upper portion of the cabin entry door, passengers have adapted to it for use in emergencies, and it does not appear from the record to have been an unnecessary challenge to the ability of passengers.

"Level of Safety Equal to that Provided by the Rule

"This petition is all about safety. In particular, the petition addresses the type of emergency exit required to facilitate the safe emergency evacuation of the Learjet Model 45 aircraft. The discussion of safe emergency evacuation must include all of the probable evacuation scenarios one can imagine, and then consider them in total to make a comparison of one configuration against another. This discussion will include level of safety in evacuations on land, planned and unplanned, with the landing gear up, down, or in any combination [Fig. Fl of the petition,

available in the Docket], and in evacuations when the airplane is in the water as a result of a planned ditching or after an unplanned overrun into water during a takeoff or landing or as a result of landing short into the water.

"First of all, the comparison which is going to be made here will be that between the Model 45 proposed door discussed [above and] in Section II of this petition, [pp 2-17 of the petition, available in the Docket] and a door which Learjet would have to design to comply with all of § 25.783(h) without exemption, and would probably be based on one of the design alternatives discussed [above and] in Section III.B of this petition." [pp 44-48 of the petition available in the Docket] Briefly, that door would appear similar to the proposed door, but operation of the upper door handle would also initiate actuation of an electric motor in the lower portion of the door, which would unlock and unlatch the mechanisms in the lower door, allowing it to open by force of gravity to provide the required floor-level Type II exit. "The time required to open this door would be longer than that required to open only the upper half [portion] of the door, and would present some other differences which will be discussed below.

"One of the most important factors in the evacuation scenario with respect to a small business jet is whether or not the landing gear is up (or collapsed) or down. The floor, and obviously the bottom of a floor-level door if there is one, is, in the case of the Model 45, only about eight inches from the ground in the event of a gear up, or collapsed gear, episode on or off a runway. It is very likely that the bottom of the fuselage will be damaged, and almost as likely that the bottom of the floor-level door could be damaged, as well. There are many obstructions which can cause this if the airplane leaves the runway, such as concrete drainage culverts, ditches, taxiway edges, runway lights, navigation aid support structures, trees, etc. There is a greater probability that the floor-level door would jam in these cases than there is with the Model 45's proposed exit. Recall from the accident data that in sixty-three percent of the known-gear-position accidents, the airplane was on its belly, and in eighty-seven percent of them, one or more of the three gear had failed. In large commercial airplanes, for which the rule was originally proposed, it is obvious from looking at Figure F2 [in the petition, available in the Docket] that the floor-level door is not likely to be damaged from a gear-up occurrence like it would be on the Model 45. There is a considerable amount of structure to crush before affecting the floor-level door.

"The gear-up or collapsed scenario is also the one in which the probability of a post-crash fire is greatest. Time is a more important factor in these gear-up cases, and the extra time required to open the total door is a disadvantage compared to the proposed door.

"Emergency evacuations from an airplane sitting on its landing gear are often not time-critical events, nor are they perceived to be." By contrast, passenger reaction and sense of urgency to evacuate from an aircraft following a gear-up landing, or crash, and sliding along on the runway or bouncing across rough terrain, is considerably different. "It is recognized that evacuation may be time-critical even in the gear-down case if there were fire, smoke, or fumes on board, or if the aircraft had collided with another aircraft or vehicle or structure." The proposed Model 45

door and the 'rule' door provide a comparable level of safety in these gear-down cases; the Model 45's proposed door would have a slight advantage because of its lesser time to open when time is critical, and the 'rule' door would have a slight advantage when time is not critical, because of the convenience of the steps.

"The proposed Model 45 door is obviously superior in any ditching scenario because, as shown in Figure F3, [in the petition, available in the Docket] the ditching waterline is below the bottom of the upper portion of the door opening. There is no need to provide some other means, such as a dam, to keep the water out as would be needed with a floor-level exit. This proposed exit is effective regardless of the circumstances of the water entry, i.e., whether it is planned or unplanned. There is no time to put a dam or other device into place in the case of an overshoot on landing or a takeoff abort overrun. The proposed door is obviously superior.

"So, in summary, in consideration of the overall level of safety in all evacuation scenarios, for this size of airplane, the proposed Model 45 door equals or increases the level of safety provided by the rule.

Gear collapsed	better
Aircraft on gear	equal
Ditching	better

"Egress Tests

"Purpose

"A number of tests were performed to compare the egress times of groups of twelve people evacuating the aircraft through two different exit configurations.

"Configurations

"The tests were done simulating the airplane sitting on its landing gear, and repeated in a configuration which simulated a belly landing, or collapse of the gear, during a landing. The first exit configuration was the upper half [portion] of the proposed Model 45 forward two-piece, clamshell entry door (30 in. wide x 36 in. high). The other exit configuration simulated a minimum Type II, floor-level, 20 in. wide x 44 in. high, entry door. The simulation was carried out by placing a piece of plywood which had a 20 in. x 44 in. opening cut in it, in the opening made by the open cabin entry door. The integral steps of the lower portion of the Model 45 entry door became part of this configuration also."

Two different Model 45 airplanes were used in these tests; one for the gear extended tests, and another for the simulated gear-up tests

"Procedures

"Two test groups were selected. Each was comprised of four women and eight men, with two over the age of fifty-five (one male, one female). No practice or rehearsal by any test participant was allowed. The participants were standing inside the test article at approximate seat locations. They were told that the goal of the test was to safely and expeditiously exit the airplane upon the 'go' command. The timing started at the go signal, and ended when the last participant was on the ground outside the test article. The tests were video-taped from inside and outside the aircraft. The first group exited the aircraft through the proposed Model 45 upper cabin door emergency exit. Then Group II exited through the simulated Type II opening, with the lower door steps also in place. Group I then exited through the simulated Type II door, and finally, Group II used the proposed Model 45 upper cabin door emergency exit. These four tests were performed with the airplane on jacks with the landing gear just touching the ground. The elevation of the padded platform outside the exit was approximately 54 inches below the bottom edge of the proposed exit opening. Two additional tests were conducted with a third group of volunteers. For these two tests, the padded platform outside the airplane was raised to an elevation level with the bottom of the fuselage to simulate a gear-up or collapsed-gear condition. The same group exited the airplane once through the upper half [portion] of the cabin door and once through the simulated Type II opening, with the integral stairs resting on the 'ground.'

"Test Data

"Aircraft standing on its gear:

	Opening [Exit Config]	
	Model 45	Type II
Group I	30 sec	17 sec
Group II	30 sec	17 sec

"Aircraft on its belly:

	Opening [Exit Config]	
	Model 45	Type II
Group III	24, 20 sec [sic]	19 sec

"Test Group Makeup

	Group I		Group II		Group III	
	age	sex	age	sex	age	sex
1.	41	M	25	M	56	M
2.	65	F	65	F	26	M
3.	35	M	36	M	30	M
4.	50	M	40	M	28	M
5.	56	M	40	M	28	M
6.	29	M	28	F	20	F
7.	27	M	20	F	39	M
8.	34	M	29	F	31	F
9.	38	M	25	M	27	M
10.	44	F	27	M	33	F
11.	31	F	28	M	31	F
12.	31	F	60	M	29	M"

"Analysis of Test Data"

First, it should be said that this test was originally proposed to us by the FAA as a means of obtaining the information (data) necessary to prove that the Model 45's proposed forward emergency exit (upper portion of cabin entry door) provided a level of safety equivalent to that provided by the rule. It was proposed in a discussion, and a test plan was prepared and sent to the FAA along with the request for the finding of equivalent safety. After some deliberation, the FAA determined instead that a petition for exemption would be the most appropriate course of action, and we proceeded in that direction, never having done the test. Following issuance of the partial grant of exemption and our decision to re-petition, we performed the test documented herein.

The data show that in the gear-down case, 17 seconds was taken to evacuate through the minimum Type II opening vs. 30 seconds through the Model 45's upper portion of the cabin entry door opening. "But these test data do not provide the complete answer. These data show only the amount of time required for 12 people to pass through different openings. The time required to produce the opening is neglected. To draw a conclusion as to the total effectiveness of one opening versus the other in a case of an emergency evacuation is erroneous unless the time required to produce the opening is considered. The comparison of time in the level of safety evaluation between the Model 45 [proposed] door and the 'rule door' must include the time required to produce the openings. In our case, the design we most likely would present as meeting the rule is a split, clamshell type door opened by one handle, with an electrically operated lower half, as described earlier in this report in one of the design options we considered. This configuration would be designed to comply with all of the rules. but would require about seven seconds longer to fully open because of the time required to electrically actuate the lower half [portion] of the door. The test was performed without considering any operating time to produce either of the openings evaluated. So, it seems that adding the seven-second operating 'delta-time' to the exit time of the Type II door would provide a reasonable

approximation to compare to the Model 45 upper-door results. The results then would be 24 seconds vs. 30 [seconds] in the case of the aircraft standing on its gear, and 26 seconds vs. 24 [seconds] with the aircraft on its belly. The adjusted test results are obviously nearly equivalent, with the Type II 'faster' in one case and the Model 45 proposed door 'faster' in the other case - both being very respectable, short times to move the maximum number of occupants through the exit to safety outside.

"Aircraft standing on its gear

	Opening [Exit Config]		
	Model 45	Type II	Type II plus 'delta'
Group I	30 sec	17 sec	24 sec
Group II	30 sec	17 sec	24 sec

"Aircraft on its belly

	Opening [Exit Config]		
	Model 45	Type II	Type II plus 'delta'
Group III	24,20 sec [sic]	19 sec	26 sec

"However, the judgment on equivalent level of safety should not be made based upon these test results alone. For the small, transport category Model 45 [aircraft], the overall level of safety provided in emergency evacuations must consider gear-up, gear-down, land, and water scenarios, as we have addressed in our petition, and the conclusion should be that the Model 45 proposed configuration does provide a level of safety equal to that provided by the rule."

Effect on Safety

"Based upon the fact that a door similarly configured to the proposed Model 45 door has been used on other Learjet Models for 30 years, and has been used in a number of successful emergency evacuations, granting this request would not adversely affect safety. This design is very similar to a proven design. A newly designed configuration may introduce more risk and greater likelihood of an adverse effect on safety than a proven design. A new, unproven design which complies with the rules provides 'prospective safety' vs the 'proven safety' of a design which has been exposed to the real world, for 30 years in this case. Surely, any adverse effect on safety would have surfaced over the last 30 years.

"Public Interest

"It is in the public interest for the FAA to grant this request for the following reasons:

"• The proposed door provides an increased level of safety over the floor-level emergency exit specified in the rule. The rule is applied equally to transport category airplanes regardless of size, and in the case of large airplanes, the rule is satisfactory. In the case of the Model 45, the floor is only a number [matter] of inches above the bottom of the fuselage, so a floor-level emergency exit may be damaged in an accident in which the landing gear is up or collapses. The proposed configuration is far less likely to jam or be rendered unusable in those situations. Therefore, an increased level of safety is provided, which is definitely in the public interest.

"• Eliminates the need to design, produce, and retrofit a different door, thereby contributing to containing design and development costs, and to a less expensive, more efficient product.

"• By containing costs, improves the potential for domestic and foreign sales. Increased foreign sales contribute to a favorable U.S. balance of trade.

"• It would facilitate the entry into service of the Learjet Model 45 following certification. Initial service entry is a critical phase in any aircraft program. A mandated return to the factory for a major modification of the door on the first year's production airplanes would unnecessarily erode the confidence of the public, and could lead to a loss of sales. It is estimated that if a reduction in sales of 20 percent was to occur, this would represent $39 million in lost revenue to Learjet in the first year based on current sales projections. Should this sales reduction persist beyond the first year and throughout the expected life of the program, the potential loss of revenue to Learjet could reach $536 million. Based on the experience to date regarding the mix of U.S. to foreign sales, this could represent a loss of export sales of $215 million over the life of the program. Lost revenue of this magnitude could severely impact the profitability of the Learjet [Model] 45 program, and hamper efforts to develop and build the next-generation Learjet in Wichita. At the present time, approximately 400 people are employed in Wichita on the Learjet [Model] 45 program, earning an estimated $14.5 million in annual wages. A reduction in sales of 20 percent leading to lower aircraft production rates could translate into a 20 percent reduction in staffing levels, representing approximately $2.9 million annually in lost wages.

A summary of the Learjet, Inc., petition was published in the Federal Register on July 2, 1997 (62 FR 127). No comments were received.

The FAA's analysis/summary is as follows:

In response to Learjet's initial petition for exemption dated April 8, 1996, the FAA issued time-limited Partial Grant of Exemption No. 6468 on June 26, 1996, with the basic condition that Learjet utilize the two-year time interval permitted (until June 15, 1998) to redesign and retrofit as necessary the Learjet Model 45's entry door to comply with the requirements of § 25.783(h). The non-compliance which prompted the petition was a consequence of an

apparent failure to realize the significance of updated certification requirements which had been defined for the Model 45 at the initiation of that development program.

The extant petition, included above, which is being addressed herein, details Learjet's efforts in complying with the aforementioned condition of that exemption, and presents their conclusion that all design solutions explored would result in a configuration that would be less desirable than the currently provided exit. The FAA considers that Learjet made a reasonable effort in this regard, but it appears that the options explored were confined to modifying the current design. Although the FAA is not basically opposed to a clamshell configuration, and even acknowledges that this configuration may represent an advantage over a more conventional door under some circumstances for this size aircraft, the FAA is convinced that Learjet could likely have provided a fully compliant clamshell door design if the design effort in that regard had been initiated "from scratch" with the development of the Model 45.

The extant petition includes an extensive accident history of Learjet aircraft with clamshell doors, which was data that Learjet had not included in support of their earlier petition. This history supports the contention that, to date, the clamshell door configuration provided has not adversely affected safety, at least to the extent that it has not been identified during any formal accident investigation as contributing to any injury or death. The FAA remains convinced, however, that a compliant design, albeit of a clamshell configuration designed to fully open both portions with a single motion when accident conditions permit, or to overpower a jammed lower portion under other accident conditions, represents the superior means of egress that the rule envisions. Learjet's own inhouse evacuation test results, although not conducted with benefit of FAA oversight, show that the floor-level exit required allows an evacuation time that is almost half that experienced with the existing "upper portion" design (17 sec. vs 30 sec.). The FAA concedes, however, that the accident history of Learjet aircraft with clamshell entry doors can not support the imposition, at this point, of what would likely be a very expensive retrofit program for Learjet. Accordingly, the FAA concludes that Learjet has satisfactorily substantiated a public interest in being permitted an exemption from the specific emergency exit door size and configuration requirements of § 25.783(h).

In consideration of the foregoing, I find that a grant of exemption is in the public interest, and should not have a significant effect on the level of safety provided by the regulations. Therefore,

pursuant to the authority contained in 49 USC 40113 and 44701, delegated to me by the Administrator (14 CFR 11.53), Learjet Inc., is hereby granted an exemption from the size and configuration requirements of § 25.783(h) for the passenger entry door on the Lear Model 45. This exemption will permit an oversized Type III exit in lieu of a Type II floor-level emergency exit. Clarification is made that exemption was not sought, nor is one granted, from any other requirements of § 25.783(h). Accordingly, as was also noted in Exemption No. 6468, the other requirements of § 25.783(h), which relate to emergency exit access, emergency lighting, etc., as they pertain to Type II exits, shall apply.

Other provisions of Exemption No. 6468, together with its conditions and limitations, remain the same and are applicable to this exemption. This amendment is part of, and shall remain attached to, Exemption No. 6468.

Issued in Renton, Washington, on December 29, 1997

/s/
James V. Devany
Acting Manager, Transport Airplane Directorate,
Aircraft Certification Service